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SUGGESTED HOISTING-SIGNAL CODE FOR METAL-MINE SHAFTS

BY

D. HARRINGTON AND J. H. EAST, JR.

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

SUGGESTED HOISTING-SIGNAL CODE FOR METAL-MINE SHAFTS[1/]

By D. Harrington[2/] and J. H. East, Jr.[3/]

A uniform hoisting-signal code for mines hoisting from more than one level, if adopted by all mining States, would be beneficial to employees and owners alike and should largely reduce the number of hoisting accidents. Misunderstood hoisting signals cause many shaft accidents involving injuries to men, damage to equipment, and loss of production from the resultant delay.

Many of the metal-mining States have adopted codes for hoisting that are effective within the borders of that State but usually entirely different from the signal code, if any, in use in an adjoining State. For many years safety engineers have recognized this lack of uniformity as a distinct hazard, but a uniform code has never been adopted by the States or by the mining industry in those States that have not incorporated signal codes in their mining laws or mining regulations.

For many reasons, miners frequently change their place of employment from one State or district to another, and this more or less constant migration makes a uniform hoisting-signal code very desirable from both a safety and an economic point of view.

A particular signal may have a different meaning in each of many State codes, hence the new workman is likely to be greatly confused when a signal that meant a definite thing to him at one mine means something entirely different at another where he has just been employed. The following examples illustrate some of the variations in the signal codes of different States.

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	State A	State B	State C	State D
Hoist, if cage is stopped	1 bell	2 bells	1 bell	1 bell
Lower	2	3	-	2
Man trip	3	8	-	3
Hoist	3-1	-	3	-
Lower	3-2	-	2	-
Hoist slowly	-	4	-	3-3-3-1
Lower slowly	-	5	-	3-3-3-2
Blasting	5	-	4	3-2-1
Danger	7	-	9	7
Release cage	1	-	-	3-3

The hoisting-signal code adopted by some States includes various operations in mining other than hoisting or movement of a cage that could probably be handled better by telephone. These signals probably were adopted before telephones came into more or less universal use for communicating from underground to the surface. Some of these signals are: "Send down drills," "Send down picks," "Turn steam on or off," "Turn air on or off." Such signals make a code cumbersome, and orders of this kind could be transmitted better by telephone.

The man-trip signals vary greatly, which makes for a particularly hazardous situation. One State uses 8 bells to signal for the man trip, followed, after the men are loaded, by 4 bells to hoist or 5 bells to lower. Another State does not have a man-trip signal but uses 3 bells to hoist men and 2 bells to lower them. Many States have adopted the 3 bell signal to indicate that men are to be handled, followed by the hoisting or lowering signal after the men are loaded. Obviously these variations are likely to result in serious accidents; in fact, many accidents have been caused by them.

The signal for blasting is another important signal that is not uniform in the various States and districts and should be standardized. Some States use 5 bells, others use 4 bells and at least one State uses the signal 3-2-1. Virtually all States that have a signal for blasting in their code have the provision that the hoist engineer must raise the cage or bucket slowly a few feet and then lower it again as an indication that the hoist engineer has understood the signal. The men mount the cage or bucket when the shots are ready to fire, and the hoisting signal is given. The codes generally provide that the hoist engineer must not accept any other signal from any other source after the blasting signal has been given and accepted until after the hoisting signal has been given and the men have been hoisted to safety.

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The danger signal of 7 bells or 9 bells, as used in different State codes, generally follows the station signal, and in most instances this signal takes precedence over all others except an accepted blasting signal.

Metal mines generally have numberous levels and stations from which hoisting operations are conducted. There is a definite lack of uniformity in station signals in the hoisting codes of different States, just as in the general signals that control hoisting operations. The tabulation below gives the signals in four States for the 5th, 10th, 15th, and 25th levels:

State	5th	10th	15th	25th
A	2-5 bells	3-5 bells	4-5 bells	6-5 bells
B	2-2	4-2	5-2	2-2-2
C	2-4	4-1	-	-
D	1-5	2-5	4-5	6-5

Even an experienced workman changing his place of employment from one State to another must learn different hoisting-operation signals and, in addition, must learn different station signals; manifestly this causes confusion and delay and may cause accidents to both men and equipment. Larger mines employ cagers to give signals and to control hoisting operations, but many smaller mines do not, requiring the individual miner to signal for the cage as needed. The sinking of winzes and use of underground hoists generally cause many persons to give hoisting signals. Some mines are operated under the "leasing" system, and in these mines each "leaser" must understand and be able to give hoisting signals properly. The Bureau of Mines believes that the employment of cage tenders, when feasible, is the safest way of controlling hoisting operations, but when an emergency occurs every person employed underground should understand the hoisting code and the way to operate the signaling device properly.

A uniform hoisting code should be designed that will require little if any change from the majority of State codes and yet be readily understood and nearly foolproof. Special signals for mining operations other than hoisting should be eliminated, as such signals make the code needlessly cumbersome and increase the danger of confusion and accidents.

The general hoisting signals controlling the hoisting, lowering, and stopping of the cage or skip could and should be the same for mines hoisting from one level as for those hoisting from more than one level.

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The code of hoisting signals for use in mines hoisting from more than one level as suggested in this publication is submitted to induce consideration of this subject by representative groups of the mining industry and to furnish a code of signals for use in those mines that are operated in States that do not have a hoisting code in their mining laws and regulations.

SUGGESTED HOISTING-SIGNAL CODE FOR METAL MINES

Signals to the Hoisting Engineer

1 bell	Hoist when cage or skip is at rest.
1 bell	Stop when cage or skip is in motion.
2 bells	Lower when cage or skip is at rest.
3 bells	Hoist or lower men. Hoist engineer must return the signal before men mount cage or skip. After men are on cage or skip, signal 1 bell to hoist or 2 bells to lower.
4 bells	Hoist or lower cage or skip slowly. Hoist engineer must return the signal; then signal 1 bell to hoist or 2 bells to lower.
5 bells	Blasting or "ready-to-shoot" signal. If hoist engineer is ready to accept signal, the bucket, skip, or cage is hoisted a few feet and lowered again. The hoist engineer must not accept any other signal after accepting the blasting signal.
9 bells	Danger. Follow by giving station signal. This calls cage or skip to that station and takes precedence over all others except the blasting signal.
1-1 bell	Releases cage or skip to hoist engineer upon completion of a hoisting operation without a cager.

Signals from Hoisting Engineer

1 bell	Signal understood. Give appropriate signal to hoist or lower.
2 bells	Send away empty cage or skip.

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The signals 3 and 4 bells require a return signal of 1 bell from the hoisting engineer to indicate that the signal is understood. The cage or skip is not moved until the appropriate follow-up signal is given to hoist or lower.

The signal 3 bells signifies men are to be hoisted or lowered; the men should not be permitted to mount the cage or skip until after the hoist engineer has returned the signal 1 bell, indicating that the signal is understood. After the men are safely on the cage or skip, the signal 1 bell is given to hoist or 2 bells to lower. The signal to move a cage should not be given until after the cage gates have been closed or other safety devices made effective.

The signal 4 bells is given when there is danger in moving a cage or skip at the normal speed or if it is desired to move same slowly for some other reason. The hoist engineer must return the signal, after which the appropriate signal to hoist or lower is given.

The blasting signal of 5 bells is really a warning signal, indicating that the miners are ready to blast. If the hoist engineer is prepared to accept the signal, the cage, skip, or bucket is hoisted a few feet and then lowered to its original position indicating that the signal is understood. The hoist engineer must not accept any other signal until the hoist signal is received and the men hoisted away from the blast.

The signal 9 bells indicates danger and is followed by the station signal to call the cage or skip to that station. This signal takes precedence over all other signals except an accepted blasting signal.

Some States use 7 bells as the signal for danger, but the proposed 9 bells is considered more distinctive and less likely to be confused with any other signal, as 6 bells is the largest number used in station identification or in hoisting operations.

A cage should be released to the hoisting engineer by giving the signal 1-1 bell after men have been hoisted or lowered in those cases where a cager or station tender is not on duty, as on idle days or on off shifts.

The hoisting engineer should not move a cage or skip from the landing until it has been released by receiving the signal 1-1 bell or until a reply is not received after repeately giving the signal 2 bells. When the hoisting engineer is satisfied there is no one at the landing or level, the cage or skip should be raised a few inches; then a pause should follow before the cage is hoisted away from that landing.

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The hoisting engineer should be fully informed before work of any kind other than normal hoisting operations is started in a shaft. He should know the character and location of the work to be done and should be notified immediately after such work is completed and normal hoisting operations can be resumed.

HOISTING-STATION IDENTIFICATION

A station-signal code should be arranged so that it is easily understood, readily memorized, and unlikely to be confused with hoisting-operation signals. The code should be placed in a prominent place at every underground and surface station where signals can be given and at places where miners congregate, such as change houses. The code should be posted in the hoist house within easy view of the hoisting engineer at all times. The lettering on the posted copies of the code should be kept in condition to be easily read.

The suggested station-signal code shown below omits the 3-bell signal as the first part of any station identification to avoid possible confusion with the 3-bell signal in the hoisting code, which indicates men are to be handled. Several State codes also omit this signal.

Two numbers can be used to identify up to 20 stations without using more than 6 bells as any one identifying signal. A three-number identification should be used where more than 20 stations are required. It has been found that more than 6 bells in any station signal is liable to be confusing. Many mines identify their working levels as station No. 1, No. 2, No. 3, etc., without regard to the actual level number. The worked-out and abandoned levels are entirely disregarded, and in this way more than 20 signals are not required even in a deep mine.

Suggested Station Signal Code

Station	Bells	Station	Bells
Collar of shaft	1-2	11	5-1
1	2-1	12	5-2
2	2-2	13	5-3
3	2-3	14	5-4
4	2-4	15	5-5
5	2-5	16	6-1
6	4-1	17	6-2
7	4-2	18	6-3
8	4-3	19	6-4
9	4-4	20	6-5
10	4-5	21	2--1-1

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Station	Bells
22	2--1-2
23	2--1-3
24	2--1-4
25	2--1-5
26	2--2-1
27	2--2-2
28	2--2-3
29	2--2-4
30	2--2-5
31	2--3-1
32	2--3-2
33	2--3-3
34	2--3-4
35	2--3-5
36	2--4-1
37	2--4-2
38	2--4-3
39	2--4-4
40	2--4-5
41	2--5-1
42	2--5-2
43	2--5-3
44	2--5-4
45	2--5-5
46	2--6-1
47	2--6-2
48	2--6-3
49	2--6-4
50	2--6-5

Safety Rules

1. In giving signals, the strokes on the bell should be given at regular intervals. The bar (-), or pause between strokes, should be given the same time as one stroke. The two bars (--) used in station-identification signals require the same time as normally given two strokes on the bell.

2. The hoisting signal equipment should be tested at least once each day, and oftener if repairs have been made in the shaft during the off shift.

3. Handling men in shafts:

   a. Men should not be permitted to mount a cage until the signal "3 bells" has been given and the hoist engineer has returned the signal.

   b. The signal to hoist or lower men should not be given until the cager or station tender is sure the men on the cage are in a safe position and no more men are on the cage than are permitted by the company's safety rules or by State law.

   c. The cager should be on the cage or skip before giving the signal to hoist or lower men.

   d. Mines equipped with telephones at the shaft landings or stations should require the cager to inform the hoist engineer by telephone that men are to be handled before the customary man-trip signals are given. The hoist eingineer must not

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move the cage or skip until after the proper electric signals are given. Preferably, all hoisting stations should be equipped with a telephone with provision for connection with the hoist engineer.

4. Hoisting-operation signals should not be given by anyone other than the cager or station tender, if they are on duty.

5. The use of an electric buzzer connected to the hoistroom is recommended to warn, the hoist engineer that someone beside the cager or station tender is giving the signal that follows.

6. New employees should be instructed in the correct way to give signals.

7. Mines employing cagers to control hoisting operations should not permit other employees to give signals, except in an emergency.

8. Signaling devices that can be operated from a moving cage are recommended.

9. The hoisting-signal code and the station-signal code should be placed at prominent places at each underground and surface landing. These codes should be kept legible at all times.

ARIZONA HOISTING SIGNAL CODE

1 bell	Stop immediately if in motion.
1 bell	Hoist muck.
1 bell	Release cage, skip, or bucket.
2 bells	Lower.
3-1 bells	Hoist men.)
3-2 bells	Lower men.) If bells rung slowly, move slowly.
4 bells	Steam on or off.
5 bells	Blasting or ready to shoot. This is a caution signal, and if the engineer is prepared to accept it, he must acknowledge by raising bucket or cage a few feet then lowering it again. After accepting this signal, engineer must be prepared to hoist men away from blast as soon as signal "1 bell" is given and must accept no other signal in the meantime.
6 bells	Air on or off.
7 bells	Danger signal, followed by station signal calls cage to that station. This signal takes precedence over all others except an accepted blasting signal.

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Station Signals

Station signals must be given before hoisting or lowering signals.

1-2	bells	Collar of shaft	2--1-2	bells	20th level
1-3	"	1st level	2--1-3	"	21st "
1-4	"	2nd "	2--1-4	"	22nd "
1-5	"	3rd "	2--1-5	"	23rd "
2-1	"	4th "	2--2-1	"	24th "
2-2	"	5th "	2--2-2	"	25th "
2-3	"	6th "	2--2-3	"	26th "
2-4	"	7th "	2--2-4	"	27th "
2-5	"	8th "	2--2-5	"	28th "
4-1	"	9th "	2--4-1	"	29th "
4-2	"	10th "	2--4-2	"	30th "
4-3	"	11th "	2--4-3	"	31st "
4-4	"	12th "	2--4-4	"	32nd "
4-5	"	13th "	2--4-5	"	33rd "
5-1	"	14th "	2--5-1	"	34th "
5-2	"	15th "	2--5-2	"	35th "
5-3	"	16th "	2--5-3	"	36th "
5-4	"	17th "	2--5-4	"	37th "
5-5	"	18th "	2--5-5	"	38th "
6-1	"	19th "	2--6-1	"	39th "

CALIFORNIA MINE SAFETY ORDERS, HOISTING SIGNALS; FEBRUARY 19, 1940

Signals from Mine to Hoist Engineer

2-1 bells, to hoist rock.
1 bell, to stop (if in motion.)
1-2 bells, to release skip
2 bells, to lower.
3-1 bells, man on; run slowly; men to be hoisted.
3-2 bells, man on; run slowly; men to be lowered.
7 bells and repeat, accident
3-3-1 bells, hoist cautiously.
3-3-2 bells, lower cautiously.
3-2-1 bells, ready to blast.

The signals "3-3-1" and "3-3-2" may be used to move a cage, go-devil, skip or bucket, whenever there is need to hoist or lower cautiously whether or not men are aboard and the engineer, when answering these signals, shall handle his hoist as though men were aboard the conveyance.

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After signal "ready to blast", engineer must give his signal when he is ready to hoist.

Engineer's signal that he is ready to hoist, is to raise the bucket, cage or skip two feet and lower it again.

Station Signal Boards

There shall be placed at each station a signboard, on which shall be displayed the number of the level and the bell signal for the station.

COLORADO OPERATING SIGNALS, EFFECTIVE JUNE 15, 1942

1 bell	Hoist.
1 bell	Stop (if in motion).
3-3 bell	Cage release.
2 bells	Lower.
3 bells	Men on.
7 bells	Shaft accident and danger signal. (The cage or other shaft conveyance must not be worked until further signals are given by ringing 8 bells, which shall signify that shaft conveyance is again free.)
3-3-3-1 bells	Hoist slowly and with great care.
3-3-3-2 bells	Lower slowly and with great care.
3-4 bells	Tool, timber, or other material on; run slowly.
3-5-3 bells	General danger and fire alarm. (This should be flashed on the electric lighting circuit, as well as on signal system.)
3-2-1 bells	Ready to shoot in or near shaft where all men are required to leave premises by hoisting conveyance before shooting. Engineer shall, after signal (3-2-1) raise cage, skip, or bucket two feet, and lower again and remain at his post until final signal is given and command executed

Level Signals

1-1 bells	First level	4-4 bells	Fourteenth level
1-2 "	Second level	4-5 "	Fifteenth level
1-3 "	Third level	5-1 "	Sixteenth level
1-4 "	Fourth level	5-2 "	Seventeenth level
1-5 "	Fifth level	5-3 "	Eighteenth level
2-1 "	Sixth level	5-4 "	Nineteenth level
2-2 "	Seventh level	5-5 "	Twentieth level
2-3 "	Eighth level	6-1 "	Twenty-first level
2-4 "	Ninth level	6-2 "	Twenty-second level
2-5 "	Tenth level	6-3 "	Twenty-third level
4-1 "	Eleventh level	6-4 "	Twenty-fourth level
4-2 "	Twelfth level	6-5 "	Twenty-fifth level
4-3 "	Thirteenth level		

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Rules Governing Signals

a. In giving ordinary signals, make strokes on a bell at regular intervals. In signal similar, "ready to shoot" (3-2-1), each pause (-) should take the same time as each stroke of the bell.

b. Engineer should not move cage, skip or bucket after receiving any signal beginning with three (3) bells, for at least five seconds.

c. Where men are to be hoisted or lowered to a certain level, first give signal of level desired, then signal for "men on, run slow" (3 bells). Men must then get on cage, skip or bucket, then give the signal to hoist or lower (1 or 2 bells).

d. After signal "ready to shoot" (3-2-1 bells), engineer must give signal that he is ready to hoist by raising and lowering the cage, skip, or bucket two feet. Miners must then give signal "men on" (3 bells), then spit the fuse, get on cage, skip or bucket and give signal to hoist.

e. Signals beginning with three (3) bells mean "Caution," and nothing in conflict therewith will be allowed. Signals to meet local demands, and not in conflict with the above, may be added by local operators; but the same must be posted in clear and legible form, in connection with the above code.

The system of using one bell for release will still be retained on smaller operations, especially shafts with pull bells.

MONTANA CODE OF MINE SIGNALS

1-bell	Hoist.
1-bell	Stop, (if in motion)
2-bells	Lower men.
3-bells	Hoist men.
4-bells	Blasting signal: Engineer must answer by raising cage or bucket a few feet and letting it back slowly. Then 1-bell, hoist men away from blast.
5-bells	Steam on.
6-bells	Steam off.
7-bells	Air on.
8-bells	Air off.
3-2-2-bells	Send down drills.
3-2-3-bells	Send down picks.
9-bells	Danger signal.

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Station Bells

Bells	Station	Bells	Station
2-1	1	7-1	26
2-2	2	7-2	27
2-3	3	7-3	28
2-4	4	7-4	29
2-5	5	7-5	30
3-1	6	8-1	31
3-2	7	8-2	32
3-3	8	8-3	33
3-4	9	8-4	34
3-5	10	8-5	35
4-1	11	9-1	36
4-2	12	9-2	37
4-3	13	9-3	38
4-4	14	9-4	39
4-5	15	9-5	40
5-1	16	10-1	41
5-2	17	10-2	42
5-3	18	10-3	43
5-4	19	10-4	44
5-5	20	10-5	45
6-1	21	11-1	46
6-2	22	11-2	47
6-3	23	11-3	48
6-4	24	11-4	49
6-5	25	11-5	50

NEVADA CODE OF BELL SIGNALS, DATED 1941

1 bell	Hoist.
1 bell	Stop (if in motion).
2 bells	Lower.
3 bells	Men on, run slow. When men are to be hoisted or lowered, give the signal for "Men on, run slow" (3 bells). Men must then get on cage or bucket, then give the signal to hoist or lower (1 or 2 bells).
4 bells	Blasting signal; engineer must answer by raising bucket a few feet and letting it back slowly; then 1 bell - hoist men away from blast.
9 bells	Danger signal (in case of fire or other danger); then ring number of station where danger exists; engineer must slow up when passing stations when men are on the cage.

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Station Bells

2 Bells, pause, 1 Bell	Station No. 1
2 Bells, pause, 2 Bells	Station No. 2
2 Bells, pause, 3 Bells	Station No. 3
2 Bells, pause, 4 Bells	Station No. 4
2 Bells, pause, 5 Bells	Station No. 5
3 Bells, pause, 2 Bells	Station No. 6
3 Bells, pause, 3 Bells	Station No. 7
3 Bells, pause, 4 Bells	Station No. 8
3 Bells, pause, 5 Bells	Station No. 9
4 Bells, pause, 1 Bell	Station No. 10
4 Bells, pause, 2 Bells	Station No. 11
4 Bells, pause, 3 Bells	Station No. 12
4 Bells, pause, 4 Bells	Station No. 13
4 Bells, pause, 5 Bells	Station No. 14

Where electric bells are used in connection with other bells:

If cage is wanted, ring station signal. Station tender will answer 1 Bell.
Reply 1 Bell to go up.
Reply 2 Bells to go below.
If station if full of ore and station tender is wanted, ring station signal and dc not answer back.
2-1-2 Bells are rung, engineer or station tender does not understand, repeat signal.
In case of danger or accident, ring station signal, station tender will reply 1 Bell; ring 9 Bells.
Signals not in conflict with the above code may be used to meet local conditions, but the same must be posted in connection with the above code.

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